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ABSTRACT
                       It is noted that although two approaches to second
language instruction--the communicative approach emphasizing genuine
language use and computer assisted instruction--have come together in
the form of some lower level reading instruction materials for
English as a second language (ESL), advanced level ESL reading
materials using computer simulation and games are not yet available.
The structures of traditional foreign language simulations and of
computer simulations are outlined and compared, and a model for
computerized foreign language simulation is outlined. One simulation
program currently used to teach elementary school students basic
geological concepts is described. Three short-term classroom-centered
studies of computer simulation in upper-intermediate and advanced
level ESL at Portland State University are then described and their
results are discussed. It is concluded that although no definitive
claim can be made, computer simulation does increase active
involvement in reading for understanding, is integrative and
flexible, requires extra time, and should be stopped when goals are
achieved and be followed immediately by followup feedback and
exercises. (MSE)

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Computer Simulation and ESL Reading

Mary A. Wu

July 1984

Introduction

About a year ago, David Wyatt pointed out in the TESOL Newsletter that

"Computer-assisted learning techniques are likely to have a major impact on

the teaching of reading" (Wyatt, 1983:9). Today, we are going to discuss the

use of computer simulation in advanced college-level ESL reading in light of

current theories and practice in ESL and CAI. We will also look at three

short-term classroom-centered studies of computer simulation in advanced

college-level ESL reading classes and make suggestions for computer simulation

and ESL reading at this level.

The Communicative Approach

As pointed out by Widdowson in Teaching Language as Communication, "The

'communicative' approach is, of course, very much in vogue at present" (Wid-

dowson, 1978:ix). The core of this approach is genuine language use. Wid-

dowson makes some fine distinctions between such terms as usage and use, sig-

nification and value, cohesion and coherence, and so on. Usage demonstrates

knowledge of linguistic rules, while use relates to the ability to use these

rules to communicate effectively; signification refers to meaning from syntax

and semantics, while value includes illocutionary acts as well. It is the

same with other items down the line, which also may be categorized as either

usage or use. The Communicative approach aims at language use and emphasizes

authentisity in the language classroom. It stresses the use of integrated

language skills, problem solving and games, focuses on process rather than

item, and brings content areas on the school curriculum into the language

classroom. Some examples of these trends might be Widdowson's suggestion of

using information transfer, simple accounts and gradual approximation to build

reading skills; textbook content on various subject matters as seen in Reading

by All Means, Readers' Choice, and so on; and the rapid development of ESP and EST.

CAI, CALL.

Alongside with these developments, there is also CAI (Computer Assisted Instruction) or CALL (Computer Assisted Language Learning), which shows the impact of the information revolution on language learning today. Drill and Practice and Tutorial are the most commonly used modes of CAI. Though they have specific features that are very much welcomed, e.g., branching and immediate feedback, and they are interactive to some extent, in terms of the communicative theory, they are still categories of language usage rather than real language use (Fig. 1). Dialogue is more open-ended. It is used in English classes to teach literature and composition but has not quite made its way into ESL yet. Simulation is widely used in all disciplines and is used somehow in ESL too. It is integrative in nature and ideal for language use. Games fall into this category, too.

	Usage	Use
	Signification	Value
	Cohesion	Coherence
	Drill & Practice	Computer Simulation
	Tutorial	Games

Figure 1. Categories of Usage and Use.

At present, in CAI and ESL reading, we have Drill and Practice and Tutorial for grammar, vocabulary, reading comprehension, including reading for main ideas, structural patterns, and specific facts and details. We also have a few simulations and games for lower level reading skills, as presented by John Higgins at an international conference in London in December 1981. However, simulations for developing higher level reading skills in ESL are still not available at this point.
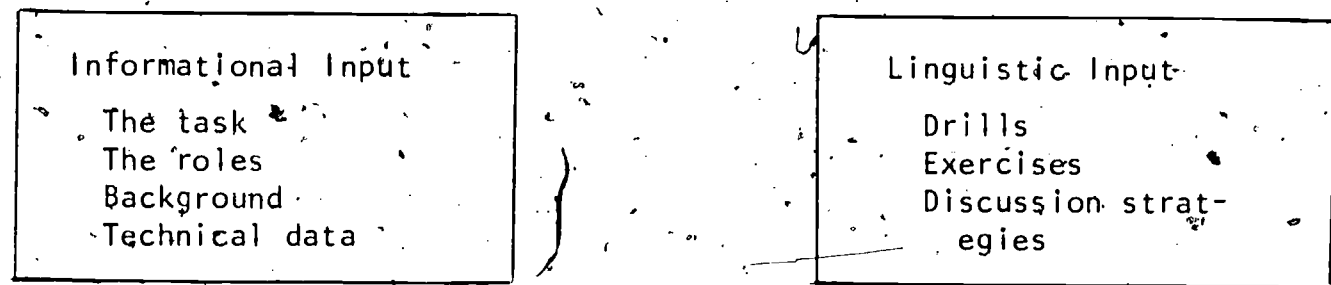
Simulation

What is a computer simulation? Let's start with regular simulations. In 1977, Kerr et al. pointed out in "Games, Simulations and Role-Playing" that "Communication games and simulations have now acquired a new respectability in the field of foreign language learning," because 1, they insure purposeful communication; and 2, they provide an excellent opportunity to integrate language skills, materials and practice; furthermore, they are interesting and relevant to learners' needs and therefore motivating (ED 148176, 1977).
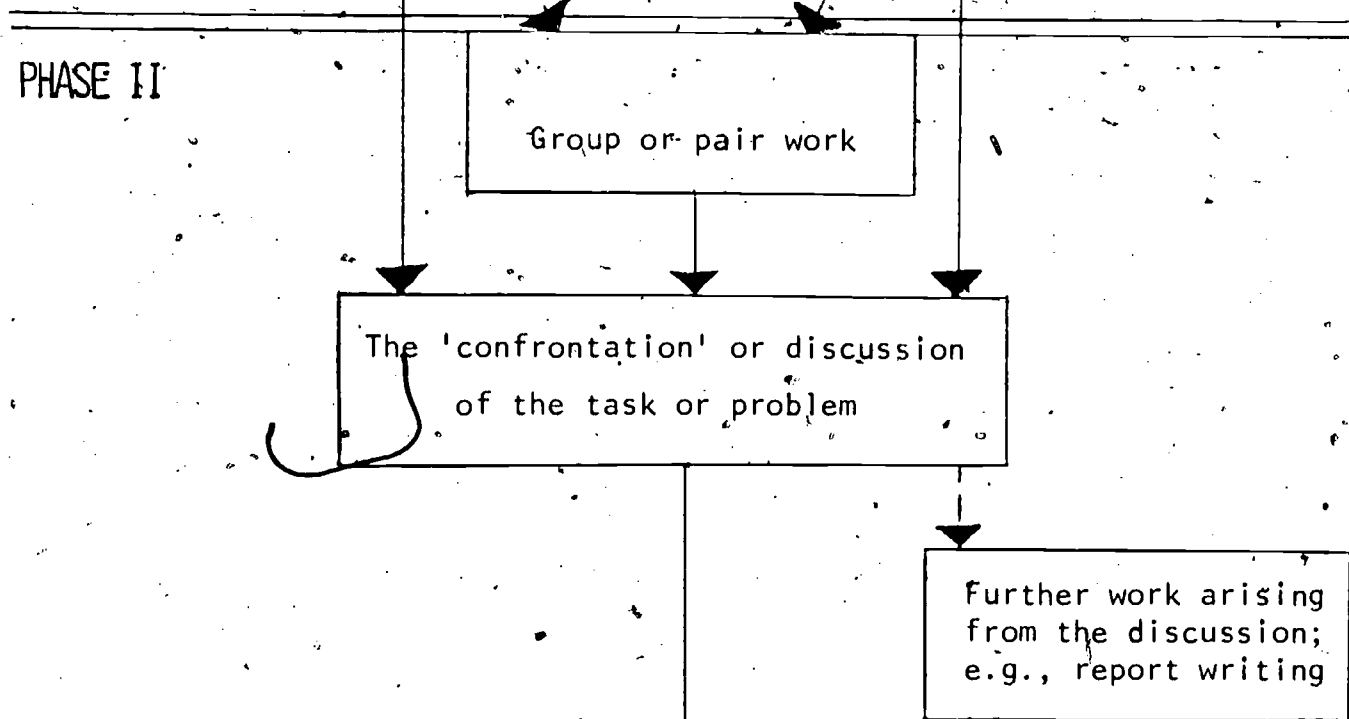
A simulation is governed more by information and data than by rules. It usually follows a set of procedures or goes through certain stages and it always has a clearly defined goal (Kerr, 1977). The following chart by Sturtridge gives a fairly good idea of the structure of a simulation (Fig. 2).

Phase I is the preparation phase, which presents the task and information; including linguistic information as well. Phase II is discussion and solving the problem. Phase III is feedback. The structure allows controlled, purposeful practice with a great deal of flexibility to meet different instructional and learning needs. For instance, as we are interested in reading skills development, in phase I we can have the students do a lot of skimming and scanning, including reading maps and graphs, for information and references. In phase II, more reading can be integrated. Phase III usually is tape-recording play back and feedback, which Sturtridge regards as most important but also most difficult to handle. Special skill and care is needed so as not to overwhelm the students with their errors after they have just enjoyed communicating with some success in phase I and phase II. For best results, Sturtridge also recommends simulations at regular intervals (Sturtridge, 1977:13).

PHASE I.

Informational Input	Linguistic Input
The task	Drills
The roles	Exercises
Background	Discussion strat-
Technical data	egies

PHASE II

Group or pair work

The 'confrontation' or discussion
of the task or problem

further work arising
from the discussion;
e.g., report writing

PHASE III

Feedback

Assessment of learner's performance
Discussion of errors
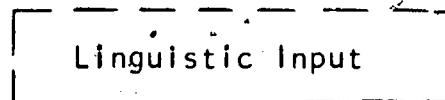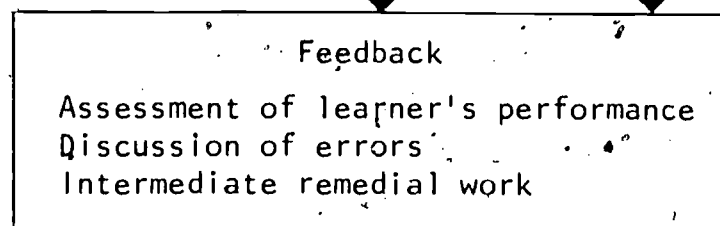Intermediate remedial work

Linguistic Input

FIG. 2   THE STRUCTURE OF A SIMULATION (Borrowed from Gill Sturtridge, ED 148176)

In summary, as suggested by Sturtridge,

> Simulations should not be regarded merely as a "fun" activity but as
> a structure that can carry materials which integrate listening, read-
> ing, writing and oral·skills; they provide the learner with an oppor-
> tunity to summon up ·and use all the language he has, which will ex-
> tend far beyond what he has been "taught" (Sturtridge; 1977:13).

Computer Simulation

Computer simulation', on the other hand, is new to the language class

though it has been a popular means in a wide variety of fields since the

1960s. As pointed out by Bonham-Carter and Harbaugh, a computer simulation

consists of three basic steps: the definition of a system; the construction of

a model, and the use of the model to imitate the behavior of the system

(Bonham-Carter, 1968:3)(Fig. 3).

```
┌─────────┐      ┌─────────┐      ┌────────────┐
│ System  │─────▶│  Model  │─────▶│ Simulation │
└─────────┘      └─────────┘      └────────────┘
```
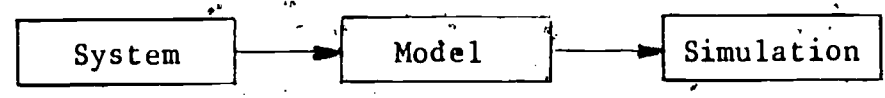
Figure 3. Three basic steps necessary for simulation of any
process or collection of processes (Bonham-Carter,
1968:3).

In step 1 we look at the real world, collect data and information and

figure out the relationship between the variables. Based on step 1, in step 2

we construct the Model, which usually stores and presents data on a discrete-

state, continuous-time basis. And in step 3, we operate on the Model to test

plans, theories and hypotheses. As it is often much more economical to test

system designs and hypotheses on a computer than to try everything out in real

life situations, comupter simulation has become an exceedingly important tool

for decision making and has entered the classroom as a tool for instruction as

well (Bonham-Carter, 1968:3-7). According to literature on computer simula-

tions, simulations of real systems provide learning opportunities that are

otherwise impossible because of cost, time, danger, or other reasons. They

intend to present problems that are "richer, more real, more encompassing, and
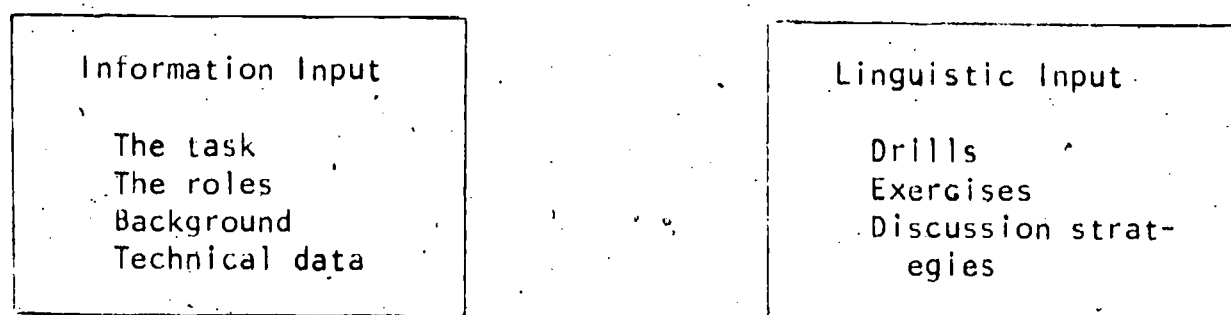
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certainly more interesting" (Bardige, 1983:46). Many computer simulations

focus on problem-solving while tackling the learning problems associated with

them. This not only makes curricular content implicit rather than explicit

(Tinker, 1983:37; Bardige, 1983:45-46), but also tests learning itself, be-

cause one usually has to understand the model and the variables quite well in

order to complete the simulation successfully (Mecc, 1980:1).

What we are most interested in here is step 3, the Simulation, where we

get to work on the model. Using computer simulations in the language class-

room gives us the advantage of bringing in not only the content of other

school subjects but also the special learning techniques used in those content

areas. Challenging and fascinating problem-solving tasks naturally shift stu-

dents' focus of attention from linguistic skills to authentic language use,

and the game factor that is usually involved makes learning fun, thus adding

favorably to the affective factors in the language class. The use of informa-

tion technology adds especially to the naturalness and authenticity of the

learning process, as it builds towards computer literacy in an information

age.

Like regular simulations, we still have three phases (Fig. 4), but the

three phases overlap somehow, as indicated by the broken lines, and there is a

better integration of skills and feedback in phase II, which we now call "The

Simulation." During this phase, the students will be interacting with the

computer as well as with one another; they will be reading for new informa-

tion, striving for a better understanding of the course content, and will be

getting feedback during the whole process, not mainly from the teacher but

from doing the job. To illustrate these points, let's have a brief look at

Geology Search and the three studies conducted at Portland State University.

PHASE I

```
┌─────────────────────────┐      ┌─────────────────────────┐
│  Information Input       │      │  Linguistic Input       │
│                         │      │                         │
│    The task             │      │    Drills               │
│    The roles            │      │    Exercises            │
│    Background           │      │    Discussion strat-    │
│    Technical data       │      │      egies              │
└─────────────────────────┘      └─────────────────────────┘
```

PHASE II

```
        ┌─────────────────────────┐
        │   Group or pair work     │
        └─────────────────────────┘

┌─────────────────────────────────────────────┐
│                                             │
│            The Simulation                   │
│                                             │
│                                             │
└─────────────────────────────────────────────┘

                          ┌─────────────────────────┐
                          │  Further work arising    │
                          │  from the simulation;    │
                          │  e.g., report writing    │
                          └─────────────────────────┘
```

PHASE III

```
┌─────────────────────────────────────────────┐
│             Feedback                        │
│                                             │
│  Assessment of learner's performance        │
│  Discussion of errors                       │
│  Remedial work                              │
│  Follow-up exercises                        │
└─────────────────────────────────────────────┘

            ┌─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
            │   Linguistic Input      │
            └─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
```
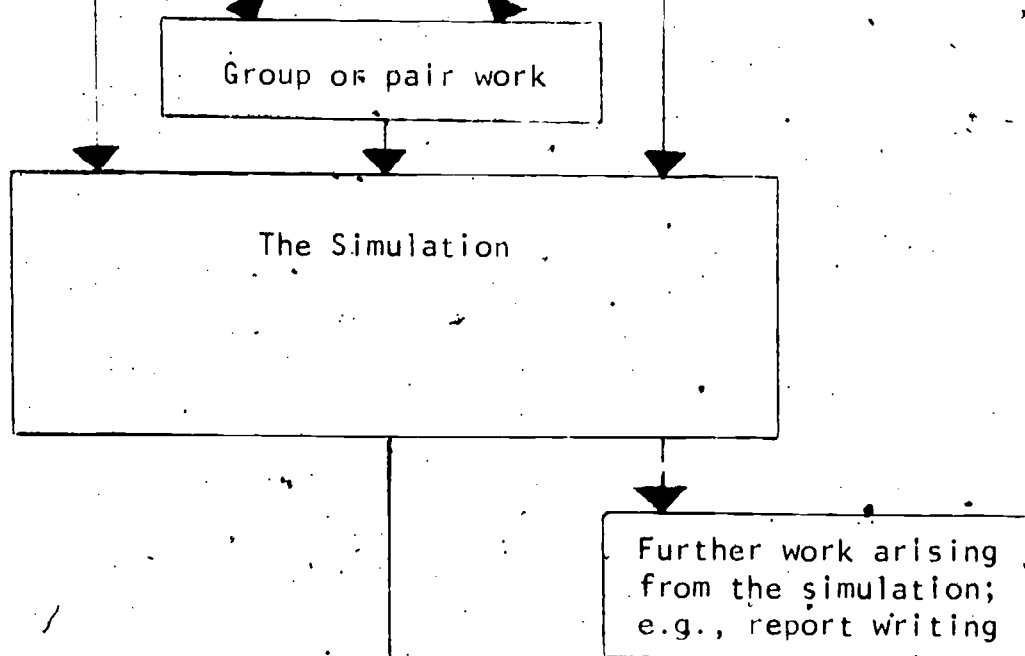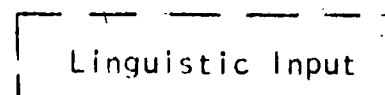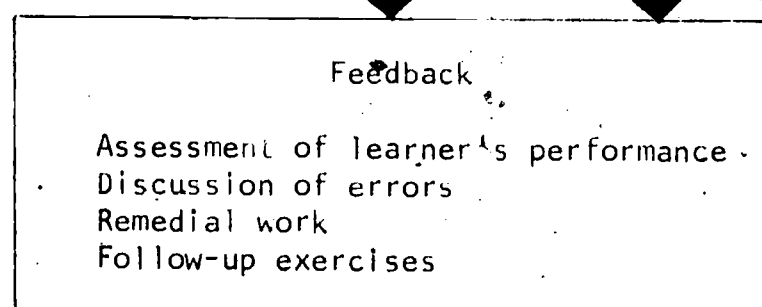
FIG. 4   THE STRUCTURE OF A COMPUTER SIMULATION IN THE LANGUAGE CLASS
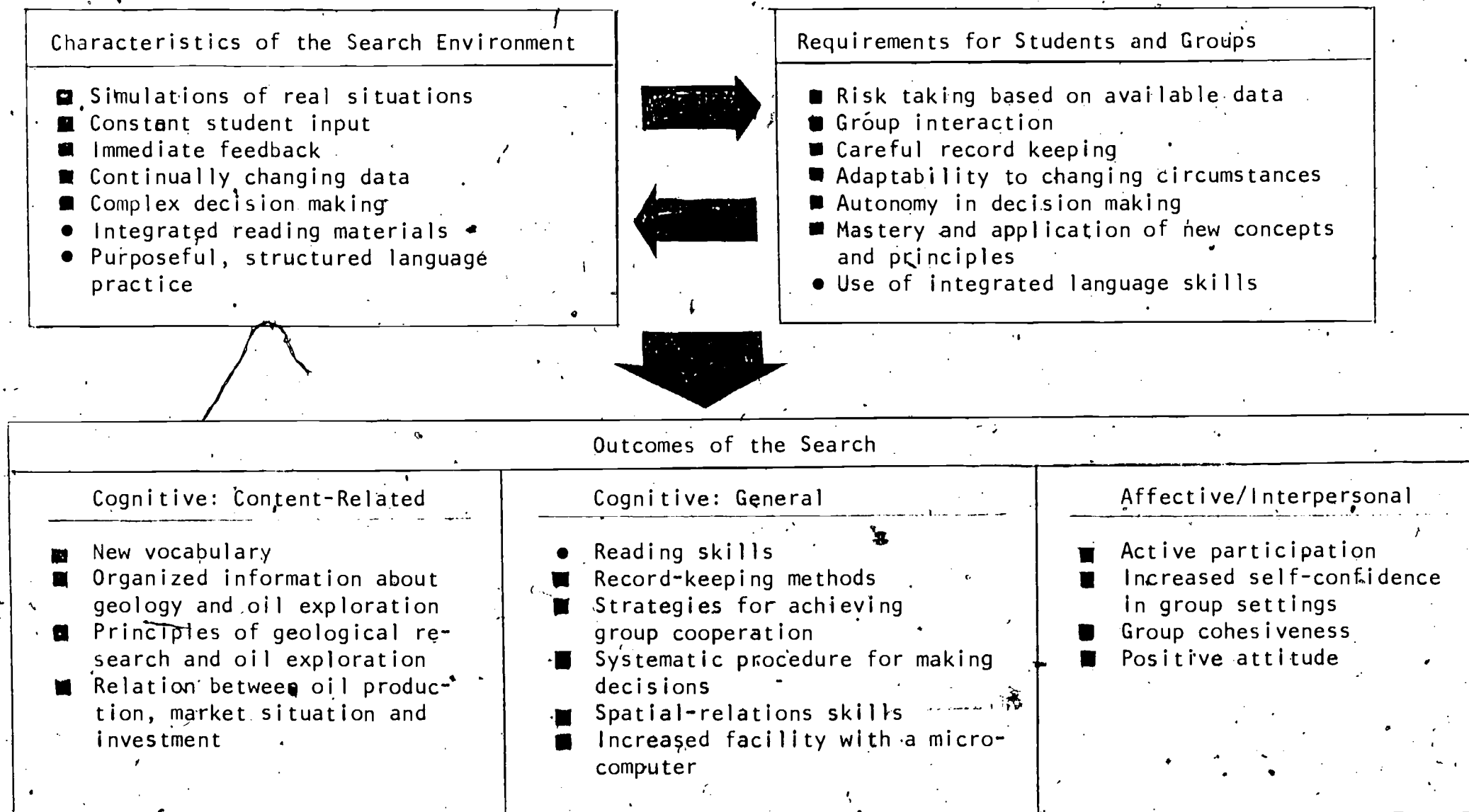
Geology Search

Geology Search is a computer simulation designed by Thomas Snyder to teach 6-Grade native speakers basic geological concepts and knowledge of oil exploration. It is also the courseware used in the three studies at Portland State. The Search courseware consists of a Teacher's Manual, a Searchbook, and the Computer Program, which is on a floppy disc.

The Teacher's Manual introduces the simulation, explains its strategies and objectives, and gives instructions and suggestions for using the Search. The chart in Fig. 5 developed from Snyder's Search series gives an overall picture of the learning strategy and expected outcome. The dots indicate features added when used for language instruction in ESL. As stated in the Teacher's Manual, capabilities of the microcomputer are utilized here to "build on and complement traditional, time-tested modes of teaching and learning" (Snyder, 1982:4), and the learning of language skills becomes less explicit as it is well contextualized and integrated in the simulation.

The Searchbook is designed to work with the simulation. It contains the text, search words, search questions, directions, maps, charts, and graphs to fill out during the simulation. The content, vocabulary and syntax,are science oriented yet not highly technical and the text is what Widdowson would call a SIMPLE ACCOUNT (1978:89). It has 7 Chapters, over 4,200 words of text, covering "New Discoveries on an Old Continent," "Two Kinds of Rock," "The Density Scan," "Core Sampling," "Seismic Blasts," "Drilling," "Selling Your Oil," and "Welcome," which serves as the preface to the reading. Unlike traditional geology and EST texts, Geology Search tells the story of Drillco scientists' search for oil in Newlandia. Students then become natural resource explorers themselves. They use Drillco as an example and apply what they have learned

Fig. 5   THE SEARCH LEARNING STRATEGY

Characteristics of the Search Environment

- Simulations of real situations
- Constant student input
- Immediate feedback
- Continually changing data
- Complex decision making
- Integrated reading materials
- Purposeful, structured language practice

Requirements for Students and Groups

- Risk taking based on available data
- Group interaction
- Careful record keeping
- Adaptability to changing circumstances
- Autonomy in decision making
- Mastery and application of new concepts and principles
- Use of integrated language skills

Outcomes of the Search

Cognitive: Content-Related	Cognitive: General	Affective/Interpersonal
New vocabulary Organized information about geology and oil exploration Principles of geological research and oil exploration Relation between oil production, market situation and investment	Reading skills Record-keeping methods Strategies for achieving group cooperation Systematic procedure for making decisions Spatial-relations skills Increased facility with a micro-computer	Active participation Increased self-confidence in group settings Group cohesiveness Positive attitude

This is developed from Snyder's Search series.

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from the reading to their own oil search. After reading the Searchbook, and probably also after some discussion, the students are ready for the simulation. This is where Geology Search goes beyond traditional teaching and learning.

The class is divided into small groups, ideally 4-5 students each. Each group chooses their own company name and types it into the microcomputer, which then keeps track of the activities. There is only one computer, and the companies take turns working on it. Brief directions appear on the screen, and when the company has given its instructions, the computer will carry them out and present test results, which might show as charts, graphics or numbers, or short statements as well. Within 6-16 seconds, the computer clears the screen, gives a short report, and it is the next company's turn. Following is a sample run of the Density Scan (Fig. 6-9):

```
┌─────────────────────────────────────────────┐
│                                             │
│    XXXXX   ACTIONS YOU CAN TAKE             │
│                                             │
│       ( )   DENSITY SCAN                    │
│       ( )   CORE SAMPLING                   │
│       ( )   SEISMIC BLAST                   │
│       ( )   DRILL A WELL                    │
│                                             │
│      (Instructions for operation)           │
│      ───────────────────────────────        │
│                                             │
└─────────────────────────────────────────────┘
```

Figure 6. Step 1 of Density Scan

Students come up to the computer when their company name occurs on the upper left hand corner of the screen. They read the instructions, move the cursor to their choice with the space bar and hit RETURN to continue.

```
CHOOSE A LETTER AND A NUMBER FOR THE TOP
LEFT SQUARE OF A 5X5 AREA ON TORRA.

    LETTER?

         PRESS <RETURN> AFTER NUMBER
                25 TOTAL SQUARES

 5


                      5
```
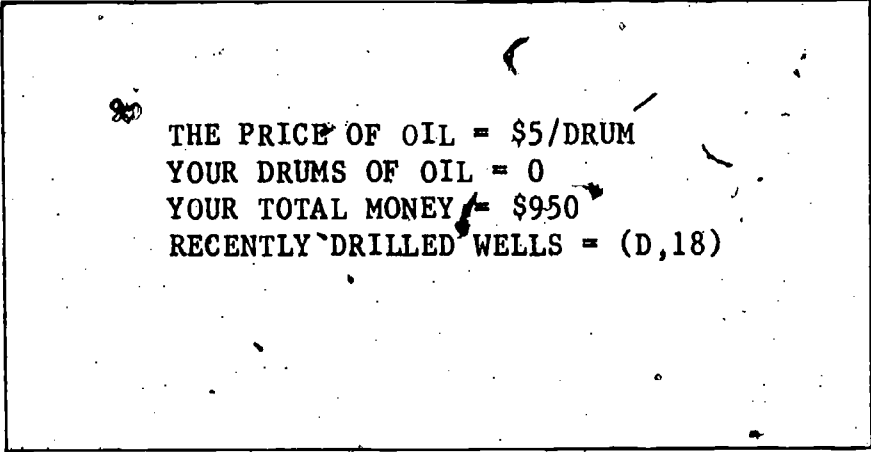
Figure 7. Step 2 of Density Scan

Students read the instructions on the screen
asking for a letter and a number for the test
site, which they decide upon through reading and
working with the map. They type the letter and
the number and hit RETURN to continue.

Figure 8. Step 3 of Density Scan

The computer displays test results. Starting
from the upper left hand corner, from left to
rignt, top to bottom, it fills the grid within
11 seconds, presents the average density under-
neath the grid, holds for another 4 seconds, and
clears the screen.

```
THE PRICE OF OIL = $5/DRUM
YOUR DRUMS OF OIL = 0
YOUR TOTAL MONEY = $950
RECENTLY DRILLED WELLS = (D,18)
```

Figure 9. Step 4 of Density Scan

> The computer reports information changes accord-
> ing to market situation and how the companies
> are doing. Within 6 seconds it clears the
> screen and it is the next company's turn.

During the simulation, when RETURN is required, as in Steps 1 and 2,

students have control over the situation and can take time in reading instruc-

tions and giving commands. When there is no RETURN required, as in Steps 3

and 4, the computer has control over the speed, which keeps the task more

challenging.

After the company had its turn, the students go back to their own corner

and work on their own data in the company. They consult their textbooks when

necessary and make decisions for their next move. The instructor may play the

role of a geological consultant, but provides no answer except where to look

for information. Emphasis is clearly on problem solving based on reading com-

prehension of the text and data on the screen. Group work is necessary, as

the company members must cooperate to collect the data on the screen within a

few seconds and depend on themselves in the simulation. As the computer pre-

sents no ERROR message nor suggestions, the process is non-evaluative and al-

lows the student to learn through trial and error and make self-corrections or

rather self-improvements. Feedback occurs not just in the end but through the

whole process.

Since the simulation requires no special operating skills and can be stopped and continued at any point, it suits different instructional needs and serves well as an introduction to computer literacy for those who have never worked on a computer before.

In summary, Geology Search combines a simple account with special features of the computer and provides an ideal learning environment for developing reading skills. It is supposed to enhance active involvement, which is crucial in reading instruction, and to allow purposeful, structured practice and the use of integrated skills. It is also believed to help improve retention of the knowledge learned.

The Three Studies

In order to see how a computer simulation actually works out in an ESL reading class, three short-term classroom-centered studies were carried out at Portland State's ESL Center. The first study was done in Spring 1983, and the other two in Winter 1984. All were conducted in natural classroom settings with upper-intermediate and advanced level ESL college students. Since this paper does not intend to report all the details, only a brief description of the procedures is presented here before discussing the results.

The first study served as a pilot run providing tentative answers to the following questions:

How can this be taught?   How do students respond?
Is the level appropriate?   What kinds of problems arise?
What kinds of potential does it have for teaching what kinds of skills?
What kind of changes should be made if used again?

As the class (G1) was an upper-intermediate level practice class that had been working with TOEFL materials throughout the term, the Search took over with a similar pattern of timed reading in the beginning. After a brief introduction to the computer simulation and an overview of the text, the

students divided up into companies and were asked to use all the skills and strategies they have acquired to read and discuss in class. In the 3rd class period, the whole class worked together highlighting main points and scanning for specific information. A student also gave a speech on his own experience in Kuwait's oil fields. We started the computer simulation in the later part of the 3rd class period, went through another class period plus an extra half hour till one company hit oil. The students were then asked to hand in their company records and to fill out a questionnaire.

The overall response is positive. All were actively involved throughout the process and would like to work more on computer simulations. Except for inference-making and record-keeping, the skills we had in mind, e.g., skimming, scanning, problem-solving, following directions, non-verbal reading and information transfer, were well practiced during the search. Based on the results, adjustments were made for the other 2 groups.

First of all is the time distribution and integration of course content (Fig.10). G1 did not have enough time to complete the task, so now more time is set aside for the simulation. G2 used regular reading class time, G3, part practice class, part reading class time, and the computer simulation was integrated with regular class content, mainly reading-skills development and rhetoric, e.g., cause and effect, comparison and contrast, outlining, skimming, scanning and inference-making. Except for the introduction and overview, reading was done at home so as to allow more time for discussion in class. There was homework for G3 and a quiz for G4. The new time arrangement also allowed more guidance and a better integration of feedback during the search.

Other differences include the instructor factor and student levels. G1 was conducted by the experimenter joined by a Graduate Teaching Assistant in the later stages. Both worked on Geology Search before. G2 and G3 were

taught by senior instructors in the program: G2 by a senior instructor alone
as part of the regular course; G3 by a senior instructor and the experimenter,
combining reading and practice classes as a whole. The instructors had read
the materials and viewed the program, but had never worked on it before.
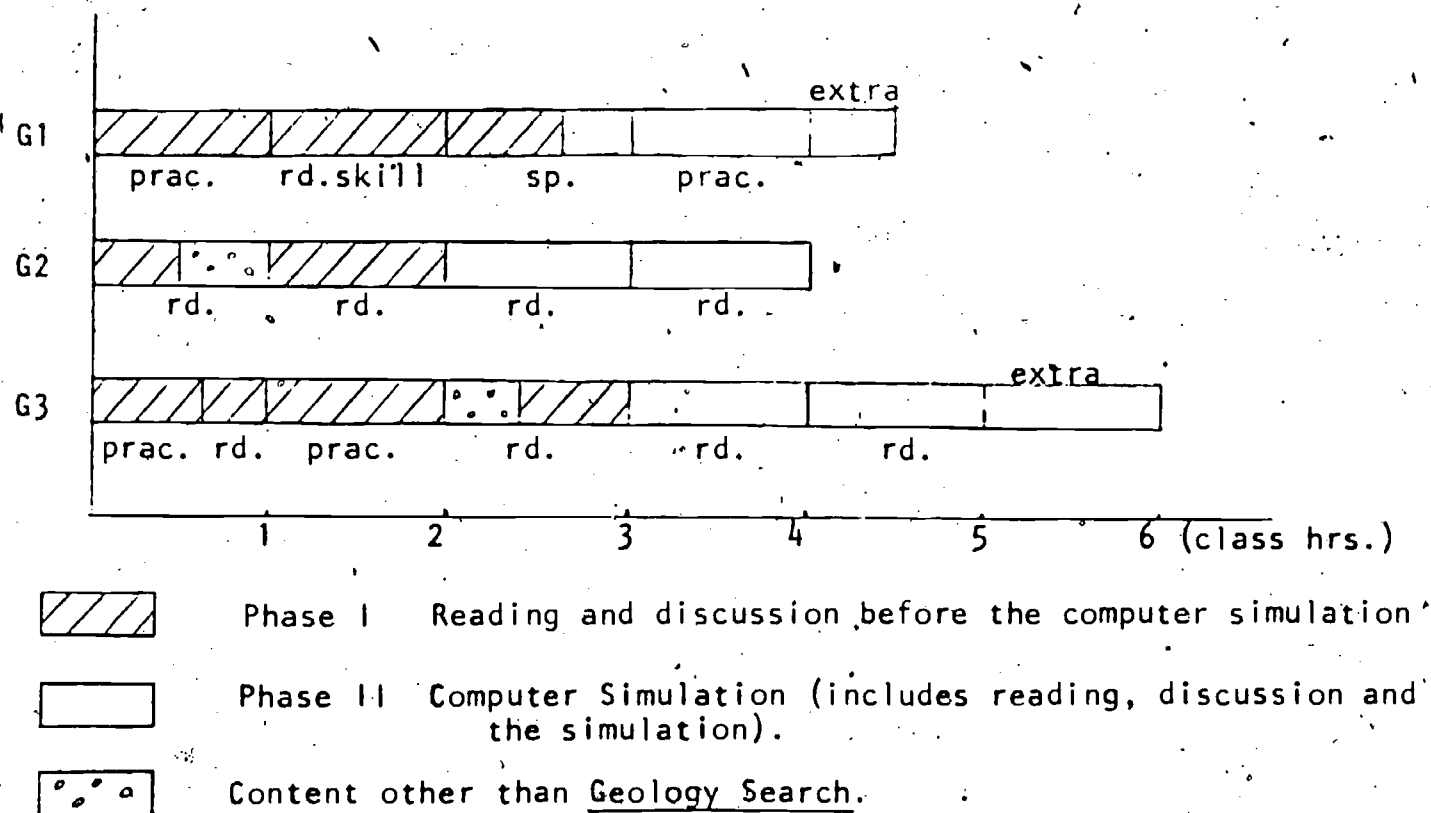

Phase I   Reading and discussion before the computer simulation

Phase II   Computer Simulation (includes reading, discussion and
           the simulation).

Content other than <u>Geology Search</u>.

Fig. 10   Time Distribution of the Studies

Student level shows a slight difference here, too (Fig. 11).
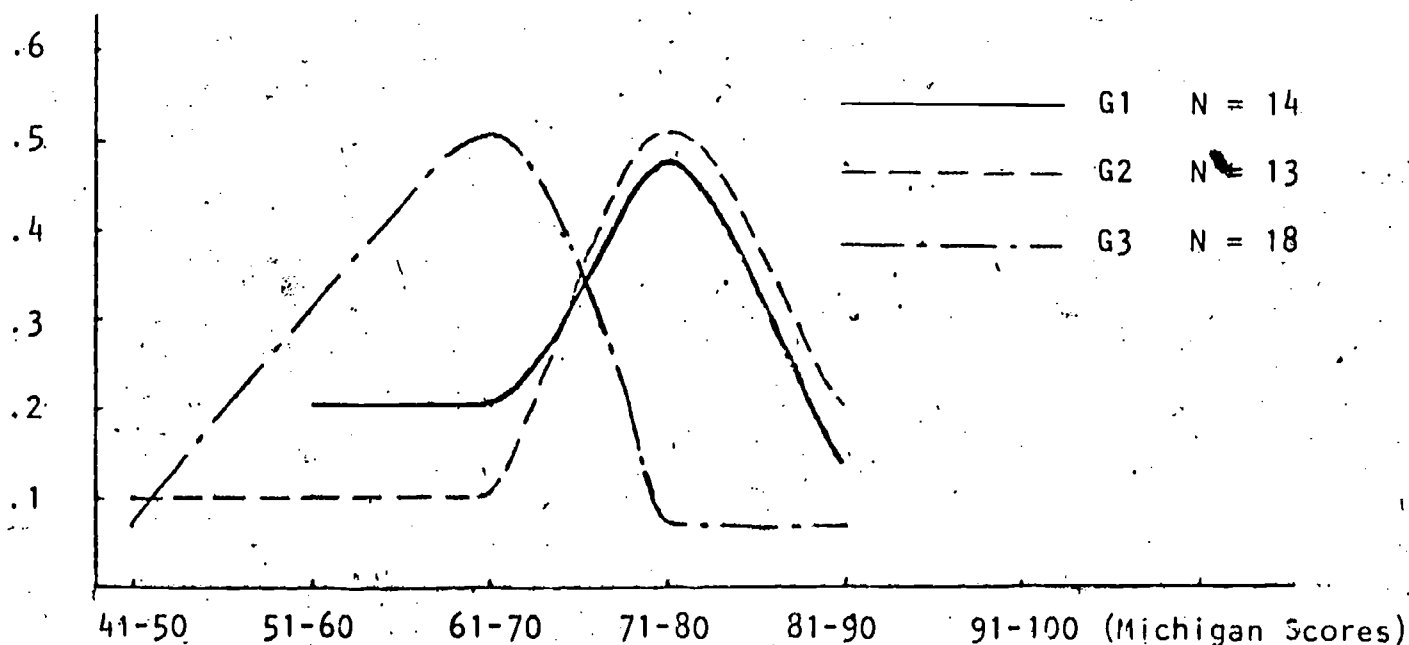
Fig. 11   Student Level   (Ratio)

G2 and G3 followed similar procedures as G1, i.e., Introduction, Over-
view, Reading, Discussion, Simulation, Collect Company Records, and Fill Ques-
tionnaire. Results show that even though each Group had specific features of
its own, the three studies did come up with some things in common that allow
generalizations.

Discussion

1. Student Involvement

In terms of group behavior, only one company out of eleven had about half
a minute digression throughout the whole process. It was when G2 was two-
thirds into the second class period with the computer. The company just hit
oil and were on their way back to their headquarters. Once they sat down,
they went right back to the Search.

In terms of individuals, there were different degrees of involvement.
Some were really enthusiastic and actively involved. They read reference ma-
terials on their own and brought their notes to class to share with others.
Some were merely participating, not contributing much to the solutions. There
were also those who do not attend class regularly and did not change just be-
cause of the simulation. However, all who attended were well occupied by the
task. They arrived early, stayed overtime when possible, and interacted with
one another as well as with the computer. They were busy reading their text
and notes, scanning for specific information, making decisions, keeping re-
cords, coordinating their group activities, and were absorbed in the task all
the way through. Considering the length of time (3-4 2/3 hrs.) students kept
up such close attention to their coursework, which is usually not easily a-
chieved in traditional reading classes, the results are positive.

2. Mastery of Content and Skills as Shown in Completion of the Task

G1: One company out of three hit oil. Besides the limitation of time, Company maps show that the two companies were having trouble with making inferences--their test sites were simply out of place.

G2: Two companies out of three hit oil. The one that failed--an Arab company--was the only company that thought they could play the game without taking the reading seriously. They blundered along, moving as they pleased. However, even these people were frequently scanning the text as they tried to interpret test results from the computer. As the simulation proceeded, they started to realize their problem and began to read the text seriously for a better understanding, though a little late for oil at this point.

G3: Four out of five companies hit oil. All made good inferences, yet one company failed as they read the map incorrectly.

Results show that reading comprehension and skills do play a crucial part in the simulation, and they are checked upon throughout the simulation by the process itself.

3. Self Assessment

Answers to the questionnaire show that 91% thought the computer simulation helped them with their English, while 9% thought it did not. Since some among the 9% checked other items indicating improvement in reading skills, the percentage of positive responses is actually higher than the figure we have. 83% thought they could now do a better job looking up information and getting main ideas; 92% thought they could do better now in processing information.

4. Attitude (student, instructor)

97% enjoyed the search, 94% would like to do more. It should be pointed out here that in the beginning, many felt puzzled as to why we were doing such

a thing that is neither like a serious lesson nor like a game, and some re-
sponded less favorably to the questionnaire because the simulation was not the
kind of instruction they were used to and therefore frustrating or not consi-
dered as serious teaching and learning. It is important that we pay special
attention to motivating the students and helping them with the transition to
this new mode of teaching and learning.

The instructors were supportive yet a little skeptical in the beginning,
not quite sure that the computer simulation would really be all that good for
their reading class. When we were half an hour into Phase II, both were very
pleased with the outcome and said they would like to teach the Search every
term and make it an on-going thing in the ESL program. The Graduate TA and
the experimenter were just as enthusiastic about the experience, which makes
responses from instructors consistently positive in the study.

Conclusion

No definitive claim can be made at this point. However, even from a ra-
ther conservative point of view, we can say that:

1. The computer simulation does increase active involvement in reading
for understanding.

2. The way the Search merged into different classes shows the integra-
tive nature of the computer simultion and its flexibility to meet different
instructional and learning needs. The point is not just to use it, but how.
Many have pointed out that CAI works best when there is a clearly defined
goal. This is true with computer simulations, too: we need to know what we
want to achieve and accordingly choose the right software and methods that
work best towards our goals.

3. Since students usually have a slow start (they needed at least an

hour and a half to get somewhere in their search), sufficient time should be
arranged for the simulation. In order to make full use of better integration
of feedback made possible by the structure, we might also want to break up the
big blocks of time (See Fig. 10) and do reading, simulation, more reading and
discussion, and more simulation so as to provide more guidance and have more
control over student progress during the process.

4. The simulation should be stopped when the goals are achieved and,
ideally, followed by exercises that build on the SIMPLE ACCOUNT through grad-
ual approximation towards more complex reading materials and skills. As fol-
low-up feedback and exercises relate more to curriculum design and planning
and are beyond the scope of the studies, we did not do any work in this area.
It is hoped that further research will be done in these areas and reports made
available before long.

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